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humanizing or personifying the plant through attributing to it various human concepts, such as fear, reason and the like.

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NOTES ON METEOROLOGY AND CLIMATOLOGY

RAPID progress is being made in the United States in the opportunities for instruction offered to students in meteorology and climatology. Moreover, college students, especially those in medicine, engineering, agriculture and forestry, are showing an increasing interest in these sciences. At the University of Minnesota, where instruction in meteorology was first given only four years ago, the classes under Professor E. M. Lehnerts last year numbered eighty-seven students, being the largest in this branch of science in the country. At the University of Wisconsin there is now a separate department of meteorology in which three courses open to undergraduates and four courses open to graduates and undergraduates are given by Mr. Eric R. Miller, of the U. S. Weather Bureau. As a result of the policy of the university to cooperate with the scientific branches of the national government, the local office of the Weather Bureau is located in one of its buildings, North Hall, and the official in charge lectures in the university. A similar situation is found at Johns Hopkins University. At the University of Nevada instruction in meteorology will be offered for the first time during the coming college year. It will be given by Mr. S. P. Fergusson, formerly of Blue Hill Observatory, who during the past year has had charge of the meteorological work at the Experiment Station in Reno. Mr. W. G. Reed, Jr., for several years past an assistant under Professor Ward in Harvard University, goes to the University of California at the beginning of the new year to teach meteorology and climatology.

A new edition of the "International Cloud Atlas" has just been prepared by MM. A. Hildebrandsson and L. Teisserenc de Bort, to

whom the publication of the work has been entrusted by the International Meteorological Committee. The first edition of the atlas, which appeared in 1895, was soon out of print, but it accomplished its purpose—international uniformity in cloud nomenclature and the recording and publication of cloud data by means of symbols. At the International Meteorological Conference at Innsbruck in 1905 certain improvements were suggested, and these have been incorporated in the new edition. The latter consists of complete definitions of the various kinds of clouds and instructions to observers, all printed in three languages, together with twenty-nine photographs of the various types of clouds, which, with their backgrounds, are shaded and colored as in nature. Only clouds of typical form are shown, making it an easy matter for one to recognize the various kinds of clouds and to learn the names by which they are known. The more important changes made in the second edition as a result of the resolutions of the Innsbruck Conference are the following: (1) Stratus cloud is defined as "a uniform layer of cloud resembling a fog but not resting on the ground," instead of "a horizontal sheet of lifted fog." The complete absence of details of structure differentiates stratus from other compact cloud forms. (2) A new term, lenticularis, is used for certain cloud forms, particularly frequent on days of sirocco, mistral or foehn, which have an oval shape and occasionally show iridescence. Clouds of this kind are cumulus lenticularis and stratus lenticularis. (3) Observers are urged to designate, by means of a special symbol, a cloud which is specially characteristic of its type, or a cloud from which rain falls. (4) Distinction is also made between a fog which wets exposed surfaces and one in which exposed surfaces remain dry.

REPRESENTATIVES of the weather services of two foreign countries visited the United States recently to study the methods used here. One was Professor Torahiko Terada, of Tokio, Japan, who is at present on a tour

around the world investigating the aerological work of the leading nations. The weather service of Japan is about to inaugurate research of this kind, and for this reason Professor Terada was delegated with the task of studying the methods and inspecting the apparatus now in use in other countries. The second representative was Mr. Edward C. Barton, of Brisbane, Australia, who visited the United States and Canada for the purpose of studying meteorological work with the hope that the information thus gained might be used to improve the Australian weather service. Methods of collecting and disseminating data, forecasting, the publication of weather maps and the instruction offered both under the government and independently among the colleges were especially investigated by Mr. Barton. Pilot and sounding balloons are now used in upper air research in Australia, but kite flying for meteorological purposes has not been begun as yet.

A PAPER entitled "The Vertical Temperature Distribution in the Atmosphere Over England, and Some Remarks on the General and Local Circulation" was read before the Royal Society of London by Mr. W. H. Dines on May 11, 1911, and is published in the transactions of that society. It is based upon the results obtained from about two hundred sounding balloon ascensions in England during the last four years. He says, "Any one working up these figures can not fail to notice that the temperature of the upper air over England is largely dependent upon the height of the barometer, and that above ten kilometers the temperature is far more dependent upon the barometer than it is upon the season." Tables which he gives show that the lower strata are cold in a cyclone and warm in an anticyclone, a condition which is reversed above. At ten kilometers the intermediate type of weather has the lowest temperature, the temperature gradient ceasing at eight kilometers in the cyclone, but not until twelve kilometers in the anticyclone. Temperature conditions indicate an ascending current in a cyclone starting close to the ground

and reaching up to the isothermal region, the stratosphere, and extending over a larger and larger area as it rises, the whole forming roughly the frustrum of a cone with its apex downwards. In an anticyclone it starts from a height of about eleven kilometers, spreading out as it descends, it too forming a cone, but with its apex upwards. The height of the isothermal region varies directly with the barometric pressure at the ground, while the temperature of the air at the commencement of the isothermal varies inversely as the latter. He also finds that the annual range in temperature decreases from the surface up to two or three kilometers; it then continues nearly constant up to about eleven kilometers, at which point it is abruptly reduced to less than half its former value. In the strata above one or two kilometers the maximum and minimum values are delayed for about a month, but above the point at which the vertical gradient ceases they occur at the summer and winter solstices. If the theory of local circulation given be correct it follows that the winds must continue upwards to the height at which the isobaric surfaces are level planes, or rather spheroids concentric with the earth, a height estimated at twenty kilometers.

ONE of the most valuable fields of activity of the U. S. Weather Bureau is that related to frost, concerning which several interesting articles appear in recent numbers of the *Monthly Weather Review*. In the January number Mr. W. M. Walton, Jr., tells how, after burning 3,300 gallons of fuel oil in heaters placed in a fruit orchard in Indiana during the cold April of 1910, the blossoms were protected until the twenty-second, when a high northwest wind accompanied by a temperature of 25° destroyed all prospects of tree and bush fruit crops. However, two acres of strawberries gave an abnormally large crop after they had been protected by means of 180 oil heaters during three nights of frost with temperatures down to 25° and lower. In two papers in the February number, Professor Alexander G. McAdie, of San Fran-

cisco, tells of efforts to protect California fruits from frosts. It is a matter of credit to the Weather Bureau and its California forecasters that during the winter of 1909-10 in that state there was not a single forecast of injurious frost that was not fully verified, and, what is more satisfactory, there was not a single frost injurious to fruit occurring during that period which was not forecast from twelve to thirty-six hours in advance. Efforts are being made to select hardy plants which will resist low temperatures, to render the plant dormant and not sensitive during the cold periods, and also to fight the cold and minimize exposure thereto by producing heat artificially. In the April number Mr. E. M. Gruss, of Houston Heights, Texas, tells of the beneficial effects of smudge fires to protect the fruit and garden crops in the southern part of that state by means of checking the nocturnal radiation. He points out the necessity of rapid action the moment frost is predicted, and also recommends the use of temporary coverings of hay, straw, soil, slatted roofs or mats, or by means of flooding or spraying. At Grand Junction, Col., in the vicinity of which temperatures as low as 15° were observed on the night of April 12 last, ample forecasts were widely disseminated by telephone, and orchard temperatures were kept above the danger point by means of artificial heating. In the same number of the *Review* Dr. P. F. Homer, of Pleasant Grove, Utah, tells of work being done there to determine the resistance of fruit buds to frost and the factors which bring about the remarkable differences noted whereby a freeze will kill one bud on a twig and leave unharmed another one adjacent to it, or will destroy the blossoms on one tree and not affect another of the same species near by. Mr. W. E. Bonnett, local forecaster at Fresno, Cal., also tells of successful efforts in fighting frost in the California vineyards. On April 13, when the most damaging frost in many years occurred near Fresno, and reliable instruments recorded temperatures of 27°, vineyards were protected by means of fire pots in which was burned a specially prepared fuel of sawdust and shav-

ings. He points out the fact that danger from frosts lies within very narrow limits, and states that growers in his vicinity are awakening to the fact that complete protection is easy and sure. In another note Professor McAdie describes a new device called an "antifrost candle," a cartridge which consists of a cylindrical tube containing slow-burning material. These cartridges are suspended in an orchard just beneath the fruit, the ends are lighted, and the heat produced is distributed at the particular level where it is most needed.

ANDREW H. PALMER

BLUE HILL OBSERVATORY,

August 1, 1911

SPECIAL ARTICLES

THE NITROGEN AND HUMUS PROBLEM IN DRY-FARMING

THE Utah Experiment Station has been conducting investigations for several years regarding the effect of crop production, under strictly dry-farming methods, upon the nitrogen and humus content of the soil. A preliminary report¹ of this work was issued last year. The writer found, contrary to the teachings of modern agriculture, that crop production had not caused a decrease in the nitrogen and humus content of the cultivated soil when compared with that of the adjacent virgin soil.

Recently a criticism of this report appeared in *SCIENCE*² written by Mr. C. S. Scofield, of the United States Department of Agriculture. There are two main points in Mr. Scofield's criticism: first, the characteristic cultural methods in vogue in the Cache Valley, Utah, were not emphasized so as to bring out the differences between these and the methods in vogue in the Great Plains area of the United States; second, the noted increase in nitrogen and humus content was not correlated with the yields on the cropped land.

¹ Utah Experiment Station, Bulletin No. 109.

² *SCIENCE*, Vol. XXXIII., No. 855, May 19, 1911, p. 780.